Groatite  
\(\text{NaCaMn}^{2+}_2(\text{PO}_4)[\text{PO}_3(\text{OH})]_2\)

**Crystal Data:** Monoclinic.  
*Point Group:* 2/m.  
As divergent to stellate sprays of acicular crystals, to 1 mm.

**Physical Properties:**  
*Cleavage:* None observed.  
*Fracture:* Uneven.  
*Tenacity:* Brittle.  
*Hardness:* 3  
*D(meas.)* = n.d.  
*D(calc.)* = 3.213

**Optical Properties:**  
*Translucent.*  
*Color:* Colorless to pale yellow, pale orange.  
*Streak:* White.  
*Luster:* Vitreous.  
*Optical Class:* Biaxial (+).  
\(\alpha = 1.622(1)\)  
\(\beta = 1.634(1)\)  
\(\gamma = 1.663(1)\)  
2V (meas.) = 67\(^\circ\)  
2V (calc.) = 66.5\(^\circ\)  
*Orientation:* \(X^a = 35.4\) (in \(\beta\) obtuse); \(Y^c = 10.1\)\(^\circ\) (in \(\beta\) acute); \(Z \parallel b\).

**Cell Data:**  
*Space Group:* C2/c.  
\(a = 12.5435(9)\)  
\(b = 12.4324(9)\)  
\(c = 6.7121(4)\)  
\(\beta = 115.332(2)\)\(^\circ\)  
\(Z = 4\)

**X-ray Powder Pattern:**  
Tanco Mine, Lake Bernic, Manitoba, Canada.  
3.187 (100), 2.726 (90), 6.204 (80), 2.788 (80), 5.655 (70), 2.580 (70), 3.608 (30)

**Chemistry:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{P}_2\text{O}_5)</td>
<td>46.66</td>
</tr>
<tr>
<td>(\text{FeO})</td>
<td>0.49</td>
</tr>
<tr>
<td>(\text{MnO})</td>
<td>29.31</td>
</tr>
<tr>
<td>(\text{CaO})</td>
<td>12.51</td>
</tr>
<tr>
<td>(\text{Na}_2\text{O})</td>
<td>6.87</td>
</tr>
<tr>
<td>(\text{H}_2\text{O})</td>
<td>3.93</td>
</tr>
<tr>
<td>Total</td>
<td>99.77</td>
</tr>
</tbody>
</table>

(1) Tanco Mine, Lake Bernic, Manitoba, Canada; average of 4 electron microprobe analyses, \(\text{H}_2\text{O}\) from stoichiometry, corresponding to  
\(\text{Na}_{1.02}\text{Ca}_{1.02}(\text{Mn}_{1.96}\text{Fe}^{2+}_{0.03})\Sigma_{1.99}\text{P}_{3.02}\text{O}_{10}(\text{OH})_2\).

**Group:** Alluaudite group.

**Occurrence:**  
A late-stage mineral, most likely derived from the dissolution of lithiophosphate and lithiophilite, in a spodumene-rich portion of a zoned petalite-subgroup pegmatite.

**Association:** Whitlockite, crandallite, an unidentified Na–Al phosphate, quartz.

**Distribution:** Tanco Mine, Lake Bernic, Manitoba, Canada.

**Name:** Honors Lee A. Groat (b. 1959), professor of Mineralogy at the University of British Columbia, Vancouver, British Columbia, Canada, for his extensive contributions to pegmatite mineralogy.

**Type Material:** Royal Ontario Museum, Toronto, Canada (M40501).

**References:**  
(1) Cooper, M.A., F.C. Hawthorne, N.A. Ball, R.A. Ramik, and A.C. Roberts (2009) Groatite, \(\text{NaCaMn}^{2+}_2(\text{PO}_4)[\text{PO}_3(\text{OH})]_2\), a new mineral species of the alluaudite group from the Tanco pegmatite, Bernic Lake, Manitoba, Canada: description and crystal structure. Can Mineral, 47, 1225–1235.  
(2) (2010) Amer. Mineral., 95, 1123-1124 (abs. ref. 1).